#2

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1. Your reference

P16900GB-LH/atb

220CT02 E757388-5 D00389
P01/7700 0.00-0224429.1

2. Patent application number
(The Patent Office will fill in this part)

21 OCT 2002
0224429.1

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Autoliv Development AB
S-447 83 Vårgårda
SWEDEN

Patents ADP number *(if you know it)* 00321018009

If the applicant is a corporate body, give the country/state of its incorporation

SWEDEN

4. Title of the invention

A Safety Arrangement for a Vehicle

5. Name of your agent *(if you have one)*

Forrester Ketley & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Forrester House
52 Bounds Green Road
London
N11 2EY

Patents ADP number *(if you know it)*

133001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
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YES

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	-
Description	11
Claim *(s)*	4
Abstract	1
Drawing *(s)*	2 +2

10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature: Forrester Ketley & Co.
Forrester Ketley & Co.

Date: 21st October, 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Lloyd D. C. HOARTON (020) 8889 6622

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DUPLICATE

PATENTS ACT 1977

P16900GB - NHF/ATB/ns/cg

"A SAFETY ARRANGEMENT FOR A VEHICLE"

THIS INVENTION relates to a safety arrangement for a vehicle, and in particular concerns an improved arrangement for detecting a crash situation and controlling at least one safety device, such as an air-bag.

Modern vehicle safety systems typically comprise a main control unit, which is the hub of the system. The main control unit comprises one or more accelerometers to measure the rate of change of velocity of the vehicle, a processor operable to perform a decision algorithm on the signals output by the accelerometers in order to establish whether a crash situation has occurred and implement a crash algorithm to activate a safety device accordingly, capacitors storing sufficient ignition energy to activate the safety device, and an ignition circuit, which is controlled by the output of the crash algorithm, and which connects the capacitors to the safety device to deploy the safety device upon detection of a crash situation. The control unit may also comprise means for controlling the communications between the control unit and various external units, and have a diagnostic function.

Due to the fact that the control unit comprises accelerometers, the control units must be physically located in a part of the vehicle where the sensed acceleration will be representative of the acceleration of the vehicle as a whole. The ideal location for this purpose is the central tunnel of the vehicle,

which comprises a ridge running along the centre of the floor of the chassis of the vehicle.

Due to the number of components contained in the control unit, the control unit is rather large and heavy. It may, therefore, be difficult to allocate sufficient space to the control unit in the central tunnel of the vehicle, which is also used for many other purposes, for instance accommodating the drive shaft in a front-engine, rear wheel drive vehicle.

In addition, a heavy control unit will generate substantial vibration while the vehicle is moving, and this is likely to comprise the accuracy of the signal output by accelerometers provided therein.

It is an object of the present invention to alleviate one or more of the above difficulties.

Accordingly, one aspect of the present invention provides a vehicle safety arrangement, the arrangement comprising: a sensor unit comprising at least one sensor responsive to acceleration, the sensor unit being located substantially within a central tunnel of the vehicle; an actuator for activating a safety device, the actuator being located remotely from the sensor unit; and a control unit located remotely from the sensor unit and from the actuator, the control unit being operable to receive information from the sensor unit and to transmit an actuating command to the actuator to activate the safety device.

Advantageously, the control unit comprises no sensors responsive to acceleration.

Another aspect of the present invention provides a vehicle safety arrangement, the arrangement comprising: a sensor unit located substantially along a central longitudinal line of the vehicle, the sensor unit comprising at least one sensor responsive to acceleration; an actuator for activating a safety device, the actuator being located remotely from the sensor unit; and a control unit located remotely from the sensor unit and from the actuator, the control unit having no sensors responsive to acceleration and being operable to receive information from the sensor unit and to transmit an actuating command to the actuator to activate the safety device.

Preferably, the sensor unit comprises at least two sensors responsive to acceleration, which are configured to measure at least longitudinal and lateral acceleration of the vehicle.

Conveniently, the at least one sensor responsive to acceleration is configured to measure vertical acceleration of the vehicle.

Advantageously, the sensor unit comprises a signal processor for sampling data gathered by sensors of the sensor unit.

Preferably, the signal processor is operator to perform a crash algorithm, which causes the signal processor to instruct the control unit to transmit the actuating command to the actuator.

Conveniently, the signal processor is operable to receive the output of a decision algorithm, which determines whether the vehicle is in a crash situation.

Advantageously, the decision algorithm is performed in the control unit.

Preferably, the signal processor is operable to receive data from other remote sensors.

Conveniently, the sensor unit comprises one or more sensors operable to measure an angular velocity of the vehicle around a longitudinal axis thereof.

Advantageously, the actuator comprises an ignitor for igniting a charge to activate the safety device.

Preferably, the control unit comprises one or more capacitors configured to store sufficient energy to cause the actuator to activate the safety device.

Conveniently, the discharge of the one or more capacitors comprises the actuation command.

Advantageously, the actuator comprises a capacitor configured to store energy to activate the safety device, the capacitor being discharged to activate the safety device in response to the actuation command.

Preferably, the safety arrangement further comprises at least one left side sensor on a left side of the vehicle and at least one right side sensor on a right side of the vehicle.

Conveniently, the control unit is connected to a main battery of the vehicle, and supplies power to the sensor unit and the actuator.

Advantageously, the sensor unit has a smaller volume than that of the control unit.

Preferably, the sensor unit has a volume less than half that of the control unit.

Conveniently, the sensor unit has a smaller mass than that of the control unit.

Advantageously, the mass of the sensor unit is less than half that of the control unit.

Preferably, the sensor unit provided on a single microchip.

Conveniently, the sensor unit comprises a processor.

A further aspect of the present invention provides a vehicle comprising a safety arrangement according to any preceding claim.

In order that the present invention may be more readily understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 shows a first safety arrangement embodying the present invention;

FIGURE 2 shows a second safety arrangement embodying the present invention;

FIGURE 3 shows a third safety arrangement embodying the present invention; and

FIGURE 4 shows a fourth safety arrangement embodying the present invention.

Referring to Figure 1, a schematic representation of a first safety arrangement 1 embodying the present invention is shown. The first safety arrangement 1 comprises a control unit 2 which has a processor 3. The processor 3 is, as discussed above, operable to apply a decision algorithm to signals received from sensors (described below), to determine from these signals whether a crash situation has occurred. Such algorithms are known in the art.

The control unit 2 further comprises an ignition circuit 4, which is operable to send an actuation command to a safety device of the vehicle, for instance an air-bag, as will be described in more detail below. The ignition circuit 4 may comprise one or more substantial capacitors, which are charged with sufficient energy to activate the safety device, and the transmission of the stored energy to the safety device may comprise the actuation command.

Finally, the control unit 2 comprises a voltage regulator 5, which receives power from the vehicle battery 6, or from an alternative power source, and regulates the voltage so that it is in an appropriate form to provide power to the processor 3, the ignition circuit 4, and other components of the first safety arrangement 1.

It will be appreciated that the control unit 2 will be relatively large and heavy, particularly due to the presence of the capacitors in the ignition circuit 4.

The safety arrangement 1 further comprises a sensor unit 7, which comprises a pair of accelerometers 8, 9, one of which is orientated so as to measure longitudinal acceleration of the vehicle, and the other of which is orientated to measure lateral acceleration of the vehicle. The sensor unit 7 comprises a signal processor 10, which receives outputs from the accelerometers 8, 9 and manipulates the data to be in a suitable form for feeding to the processor 3 of the central unit 2.

Left and right sensors 11, 12 (which may also be accelerometers) are also provided, separately from the sensor unit 7, and the left and right sensors 11, 12 are configured to be located on respective left and right hand sides of the vehicle to provide additional information that may be useful in determining whether or not the vehicle has encountered a crash situation.

The safety arrangement 1 also comprises an actuator 13, in the form (in this example) of or one or more squibs or other charges which, upon activation thereof, inflate the air-bag.

As discussed above, it is important for the sensor unit 7 to be physically located on the vehicle in a position where the sensed acceleration will be representative of the acceleration of the vehicle as a whole. Hence, the sensor unit 7 is positioned substantially along a central longitudinal line of the vehicle, which will typically be in the central tunnel thereof.

However, the control unit 2, which comprises rather heavier components, is located remotely from the sensor unit 7 and indeed may be

placed in any suitable location on the vehicle, not necessarily anywhere near the central longitudinal line thereof, for instance within the dashboard of the vehicle.

The control unit 2 communicates with the sensor unit 7 over a sensor communication line 14, which may take any suitable form.

The remote location of the control unit 2 from the sensor unit 7 means that it is not necessary to house the control unit 2 in the central tunnel of the vehicle, thus alleviating the difficulty discussed above.

In addition, the relatively large vibrations that the control unit 2 will undergo during movement of the vehicle will not affect the sensor unit 7, which will therefore provide more reliable data regarding the acceleration of the vehicle.

The control unit 2 is also located remotely from the actuator 13, and communicates therewith over an activation communication line 15. As discussed above, the control unit 2 comprises an ignition circuit 4 having capacitors charged with sufficient energy to activate the actuator 13 (for instance, to activate one or more ignitors to ignite the squibs), and in this embodiment the activation communication line 15 may simply comprise a power line, with the control unit 2 initiating activation of the actuator 13 by discharging the capacitors along the power line. Alternatively, or in addition, the actuator 13, upon implementation of a crash algorithm in response to the determination of a crash situation, may comprise one or more capacitors charged with the necessary energy to activate the safety device, and in this case the activation communication line 15 may simply comprise a data

communication line, over which the control unit 2 can instruct the capacitors in the actuator 13 to discharge, thereby inflating the air-bag.

It will be appreciated that, with the above arrangement, the volume and mass of the components that are located in the central tunnel of the vehicle are kept to an absolute minimum, with the larger, more massive components being conveniently located elsewhere in the vehicle in the control unit 2.

Figure 2 shows a second safety arrangement 16 embodying the present invention. Common components between the first safety arrangement 1 discussed above and the second safety arrangement 16 are designated by like reference numerals.

In the second safety arrangement 16, the processing unit 3 in the control unit 2 receives data from the sensor unit 7 and the left and right sensors 11, 12, and performs a decision algorithm, the output of which dictates whether the crash algorithm is to be implemented, and hence whether the safety device is to be deployed. In contrast, however, to the first arrangement 1 described above, the output of the decision algorithm is fed to be signal processor 10 located in the sensor unit 7. The signal processor 10 will, upon receiving a signal from the processing unit 3 to activate the safety device, perform the crash algorithm, which will instruct the ignition circuit 4 to send an actuation command to the actuator 13.

The second safety arrangement 16 also comprises a third sensor 17 in the sensor unit 7, this third sensor 17 being position to allow measurement of movement of the vehicle in the roll axis, i.e. angular velocity of the vehicle around the longitudinal axis thereof.

Figure 3 shows a third safety arrangement 18 embodying the present invention, components thereof that are in common with the first safety arrangement 1 described above being designated by common reference numerals.

The third safety arrangement 18 comprises further sensors 19, which measure parameters of the car other than the acceleration thereof. For instance, the further sensors 19 may detect whether seat belt buckles are engaged, or may otherwise detect the presence of an occupant in a given seat of the vehicle, for instance by the weight exerted on the seat, or may measure the position of the seat or a part thereof (such as the headrest). The further sensors 19 may also gather information relating to the speed of the vehicle. The information output by the further sensors 19 is passed to the control unit 2 via an information bus 20, which allows communication between the control unit 2 and any other remote crash sensors (for instance the left and right sensors 11, 12) and the actuator 13.

The information gathered by the further sensors 19 allows the processing unit 3 of the control unit 2 to arrive at a more informed decision regarding whether to activate the safety device. For instance, if the further sensors 19 detect that the passenger seat of the vehicle is unoccupied during a crash, the control unit 2 may prevent the triggering of a passenger-side air-bag, since this is unlikely to offer protection to the occupants of the vehicle, and may hinder efforts to leave the vehicle, or remove people from the vehicle, following a crash.

Also, in the third safety arrangement 18, the sensor unit 7 is provided on a single microchip, and it will be appreciated that this arrangement further

reduces the size and mass of the components that are to be located in the central tunnel of the vehicle.

With reference to Figure 4, a fourth safety arrangement 21 embodying the present invention is shown. The fourth safety arrangement 21 is similar to the third safety arrangement 18, however the voltage regulator 5 and the ignition circuit 4 are located at the actuator 13, and the information bus 20 carries power from the actuator 13 to each of the remote units of the arrangement 21, including for instance the control unit 2 and sensor unit 7.

It will be understood that the present invention provides an improved safety arrangement, providing favourable distribution of components around a vehicle, while improving the accuracy with which a crash situation may be detected.

In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A vehicle safety arrangement, the arrangement comprising:

a sensor unit comprising at least one sensor responsive to acceleration, the sensor unit being located substantially within a central tunnel of the vehicle;

an actuator for activating a safety device, the actuator being located remotely from the sensor unit; and

a control unit located remotely from the sensor unit and from the actuator, the control unit being operable to receive information from the sensor unit and to transmit an actuating command to the actuator to activate the safety device.

2. A safety arrangement according to Claim 1, wherein the control unit comprises no sensors responsive to acceleration.

3. A vehicle safety arrangement, the arrangement comprising:

a sensor unit located substantially along a central longitudinal line of the vehicle, the sensor unit comprising at least one sensor responsive to acceleration;

an actuator for activating a safety device, the actuator being located remotely from the sensor unit; and

a control unit located remotely from the sensor unit and from the actuator, the control unit having no sensors responsive to acceleration and being operable to receive information from the sensor unit and to transmit an actuating command to the actuator to activate the safety device.

4. A safety device according to any preceding claim, wherein the sensor unit comprises at least two sensors responsive to acceleration, which are

configured to measure at least longitudinal and lateral acceleration of the vehicle.

5. A safety arrangement according to any preceding claim, wherein the at least one sensor responsive to acceleration is configured to measure vertical acceleration of the vehicle.

6. A safety arrangement according to any preceding claim, wherein the sensor unit comprises a signal processor for sampling data gathered by sensors of the sensor unit.

7. A safety arrangement according to Claim 6, wherein the signal processor is operator to perform a crash algorithm, which causes the signal processor to instruct the control unit to transmit the actuating command to the actuator.

8. A safety arrangement according to Claim 5 or 6, wherein the signal processor is operable to receive the output of a decision algorithm, which determines whether the vehicle is in a crash situation.

9. A safety arrangement according to Claim 8, wherein the decision algorithm is performed in the control unit.

10. A safety arrangement according to any of Claims 6 to 9, wherein the signal processor is operable to receive data from other remote sensors.

11. A safety arrangement according to any preceding claim, wherein the sensor unit comprises one or more sensors operable to measure an angular velocity of the vehicle around a longitudinal axis thereof.

12. A safety arrangement according to any preceding claim, wherein the actuator comprises an ignitor for igniting a charge to activate the safety device.

13. A safety arrangement according to any preceding claim, wherein the control unit comprises one or more capacitors configured to store sufficient energy to cause the actuator to activate the safety device.

14. A safety arrangement according to Claim 13, wherein the discharge of the one or more capacitors comprises the actuation command.

15. A safety arrangement according to any preceding claim, wherein the actuator comprises a capacitor configured to store energy to activate the safety device, the capacitor being discharged to activate the safety device in response to the actuation command.

16. A safety arrangement according to any preceding claim, further comprising at least one left side sensor on a left side of the vehicle and at least one right side sensor on a right side of the vehicle.

17. A safety arrangement according to any preceding claim, wherein the control unit is connected to a main battery of the vehicle, and supplies power to the sensor unit and the actuator.

18. A safety arrangement according to any preceding claim, wherein the sensor unit has a smaller volume than that of the control unit.

19. A safety arrangement according to Claim 18, wherein the sensor unit has a volume less than half that of the control unit.

20. A safety arrangement according to any preceding claim, wherein the sensor unit has a smaller mass than that of the control unit.

21. A safety arrangement according to Claim 20, wherein the mass of the sensor unit is less than half that of the control unit.

22. A safety arrangement according to any preceding claim, wherein the sensor unit provided on a single microchip.

23. A safety arrangement according to any preceding claim, wherein the sensor unit comprises a processor.

24. A vehicle comprising a safety arrangement according to any preceding claim.

25. A safety arrangement substantially as hereinbefore described, with reference to the accompanying drawings.

26. Any novel feature or combination of features disclosed herein.

ABSTRACT

A vehicle safety arrangement, the arrangement comprising: a sensor unit comprising at least one sensor responsive to acceleration; an actuator for activating a safety device, the actuator being located remotely from the sensor unit; and a control unit located remotely from the sensor unit and from the actuator, the control unit having no sensors responsive to acceleration and being operable to receive information from the sensor unit and to transmit an actuating command to the actuator to activate the safety device.

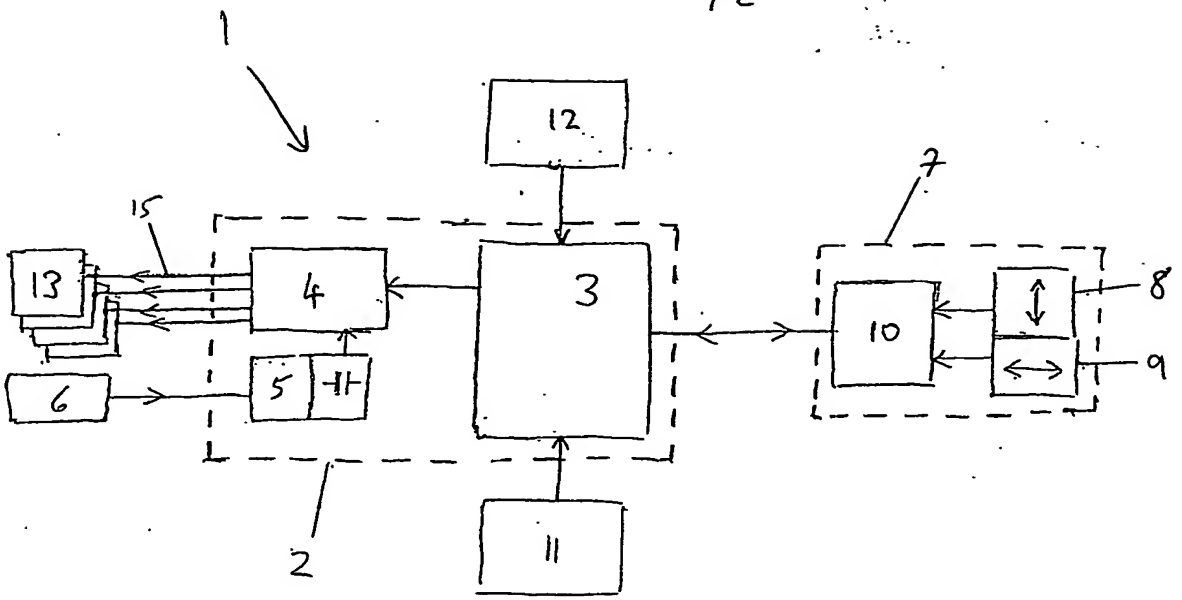

Fig 1

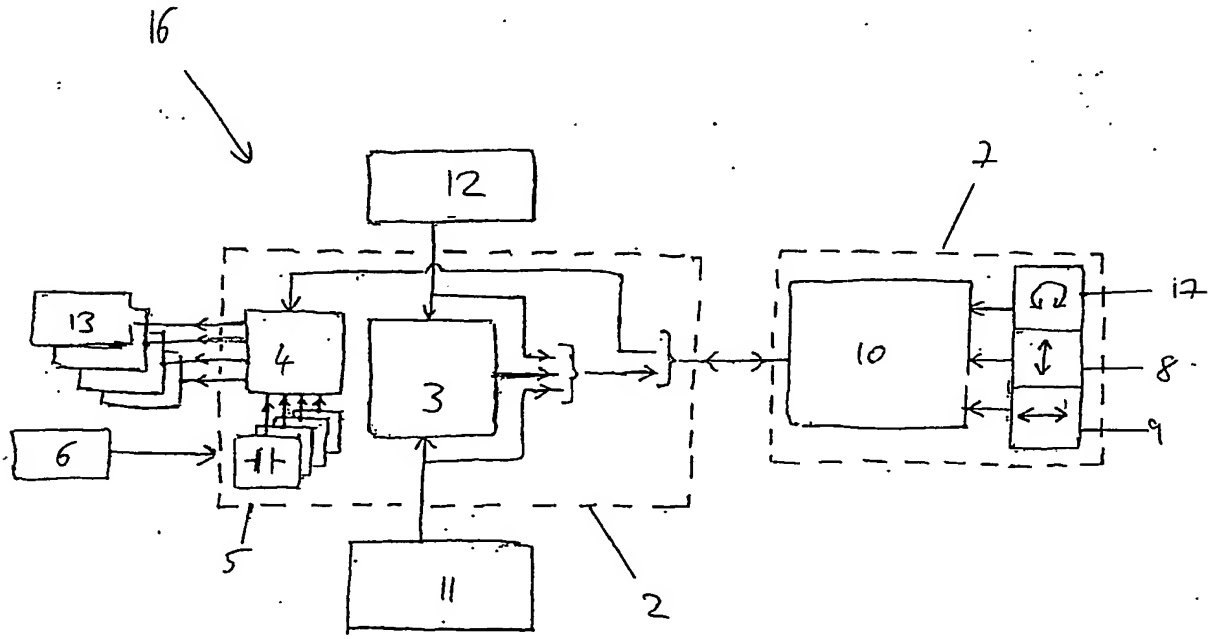

Fig 2

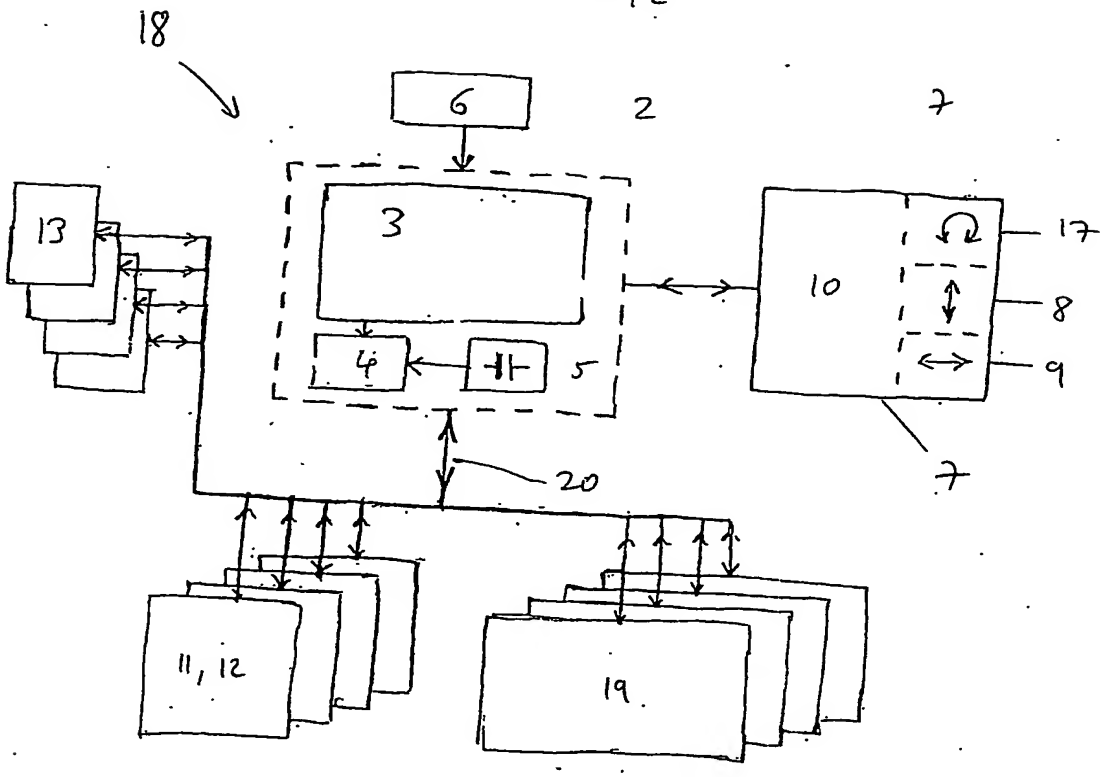

Fig 3

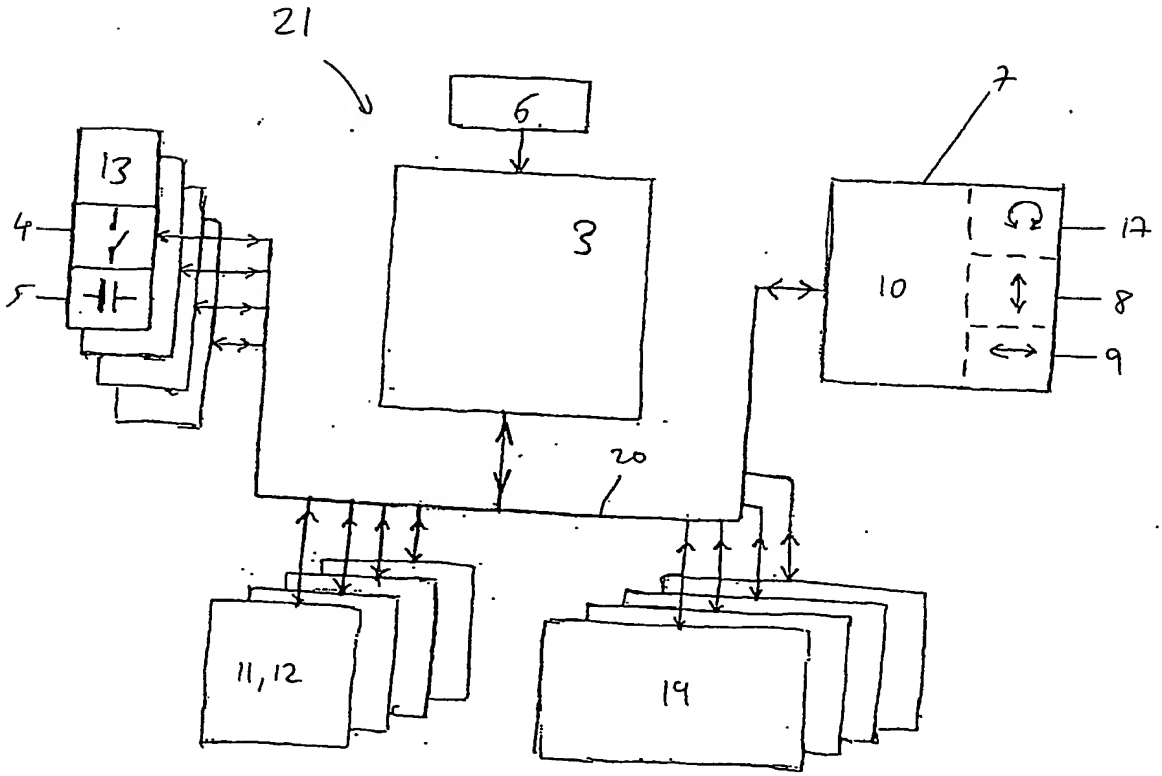

Fig 4